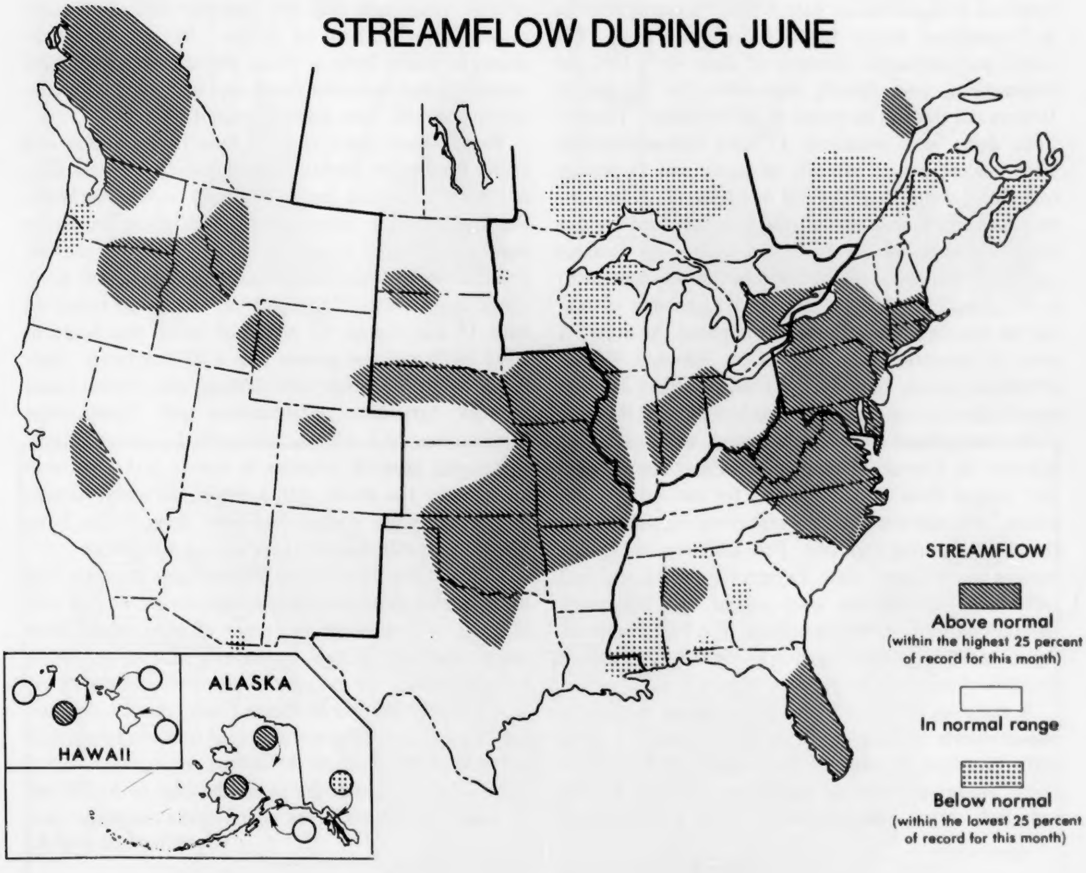
Water Resources Review

UNITED STATES
Department of the Interior
Geological Survey

CANADA
Department of the Environment
Water Resources Branch

JUNE 1982

STREAMFLOW DURING JUNE



Severe flooding, as a result of torrential rains in the southern New England States and in parts of Iowa, caused flow rates on several streams that are not likely to be exceeded more than once (on the average) in 100 years or more. Property damage was in excess of $276 million in Connecticut alone. Floods also struck many other areas of the United States, with streams flowing at record high rates for June in parts of Florida, Kansas, Missouri, Nebraska, North Carolina, and South Carolina.

Contents of major reservoirs were generally above average except in parts of Colorado, New Mexico, Quebec, Tennessee, Texas, and Wyoming.

STREAMFLOW CONDITIONS DURING JUNE 1982

Streamflow was in the above-normal range throughout much of the East and Midwest during June as a result of runoff from above-normal precipitation in those areas. Scattered regional and local flooding occurred in New England, Arkansas, Florida, Iowa, Kansas, Missouri, and Nebraska, and was highest of record at many gaging stations. The accompanying table and map, on pages 4, 5, show peak stage and discharge data and locations of measurement sites at selected gaging stations in Connecticut, Rhode Island, Florida, and Iowa. The storm and associated flooding of June 4–7, 1982, in **Connecticut**, were directly responsible for the loss of 10 lives and damage in excess of $276 million. Twenty-three dams were breached, 17 state highway bridges were washed out or severely damaged, and 36 sewage treatment plants were flooded or bypassed. Numerous State and town roads and railroad beds sustained damage from washouts and $4 million in agricultural damages occurred. Industrial and commercial damages amounted to $92.7 million. Many cellars and basements of residential dwellings were flooded throughout the State. A state of emergency was declared by Governor William O'Neill on Sunday June 6 and the four southern counties were declared a major disaster area by President Reagan.

In **Connecticut** and **Rhode Island**, severe flooding occurred as a result of rapid runoff from intense rains that ranged from 3 to 14 inches for the 4-day storm period. Damage was especially high along coastal streams that crested during high tide. Peak discharges on several streams in the area were highest of record and had recurrence intervals that were greater than 100 years. Monthly mean flow of Salmon River near East Hampton, Conn. increased sharply and was highest for June in 54 years of record. (See graph on page 3.)

A sampling of peak discharges at gaging stations in **Massachusetts** indicated that the storm produced peaks with recurrence intervals of 5–20 years. A mid-month storm produced excessive rainfall in southern **Florida** and high tides associated with that storm caused extensive flooding along Florida's west coast. On June 14, 15, runoff from heavy rains in the Nishnabotna River basin in southwestern **Iowa** and in the Iowa River basin in central Iowa, caused severe flooding and peak discharges on several streams in those river basins were highest for period of record. Eleven counties (Mills, Page, Cass, Montgomery, Freemont, Marshall, Tama, Benton, Iowa, Johnson, and Muscatine) bore the brunt of this storm, and crop and property damage was estimated in the millions of dollars. Monthly mean discharge of Cedar River at Cedar Rapids, Iowa, decreased seasonally but remained above median for the 13th consecutive month. (See graph on page 3.)

Runoff from heavy rains on June 15, 16, also caused severe flooding in eastern **Nebraska** where the peak flow of 19,400 cubic feet per second (cfs) on Weeping Water Creek near Union (drainage area, 241 square miles) on June 15 was equal to a 40-year flood event. In the Salt Creek basin, the peak discharge of 15,600 cfs on Rock Creek near Ceresco (drainage area, 119 square miles) on June 15 was highest for period of record that began in April 1970 and was greater than a 50-year flood. Estimates of crop damage, land damage, and erosion losses by the Agricultural Stabilization and Conservation Service were 14.5 million dollars for Lancaster County alone. At least 16 counties in eastern Nebraska were hit hard by the storm with soil loss the worst seen in 30 years. Many streams had peak flows in the 3- to 5-year recurrence interval range around mid-month.

In northern and central **Missouri**, most rivers and streams were at or above flood stage during the first half of June. Floodwaters, as a result of rapid runoff from intense rains of up to 6 inches in a 12-hour period on June 9, caused the collapse of the westbound lane on U.S. Highway 36 over Medicine Creek, near Chillicothe. Agricultural damage was widespread in the northern half of the State as a result of the intense rains.

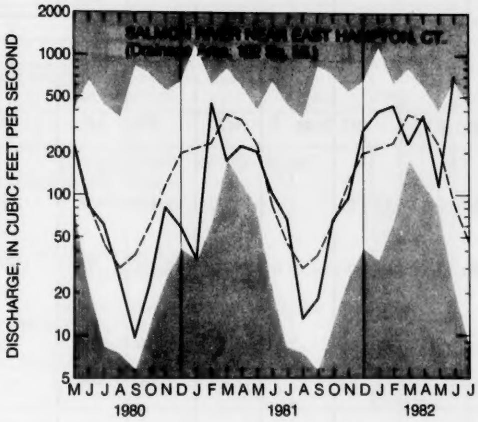
In adjacent **Kansas**, the peak discharge of 31,000 cfs on June 9 at Soldier Creek near Topeka (drainage area,

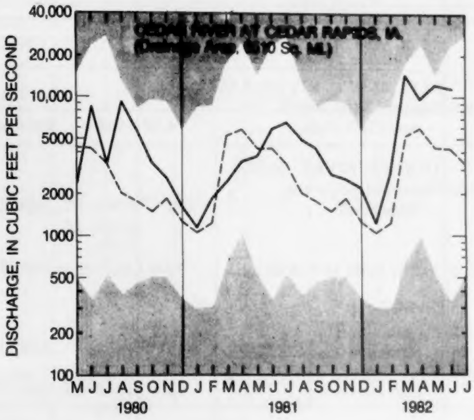
(Continued on page 6.)

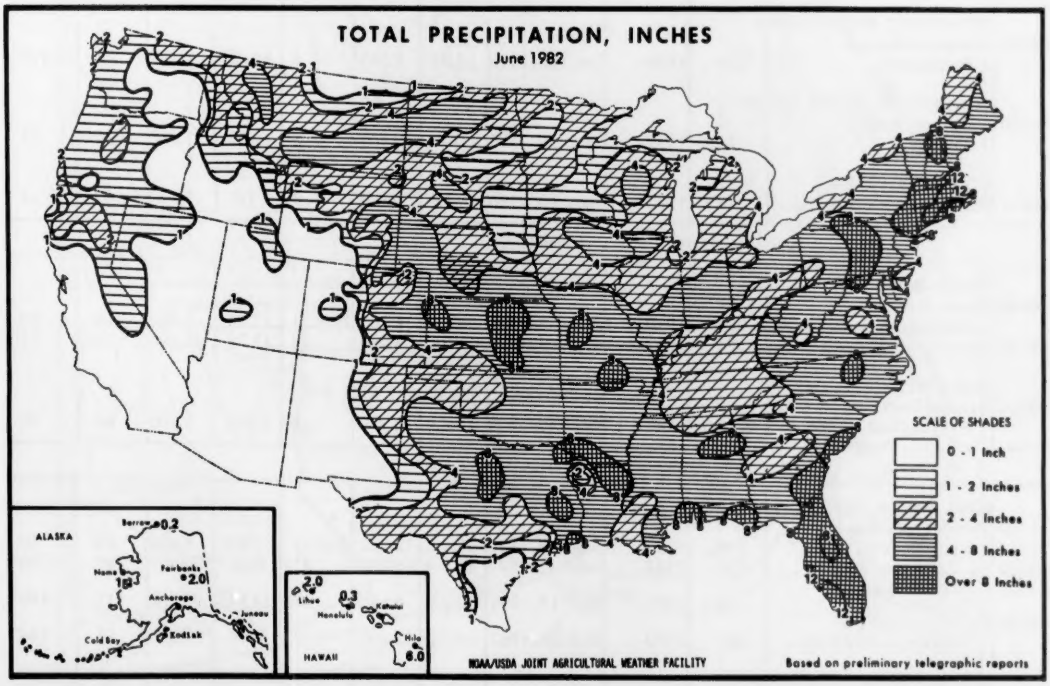
CONTENTS

SURFACE WATER–MONTHLY MEAN DISCHARGE IN KEY STREAMS

Unshaded area indicates range between highest and lowest record for the month.
Dashed line indicates median of monthly values for reference period, 1951–80.
Heavy line indicates mean for current period.







(From Weekly Weather and Crop Bulletin published by National Weather Service and Department of Agriculture.)

STAGES AND DISCHARGES FOR THE FLOODS OF JUNE 1982 AT SELECTED SITES IN CONNECTICUT, FLORIDA, IOWA, AND RHODE ISLAND

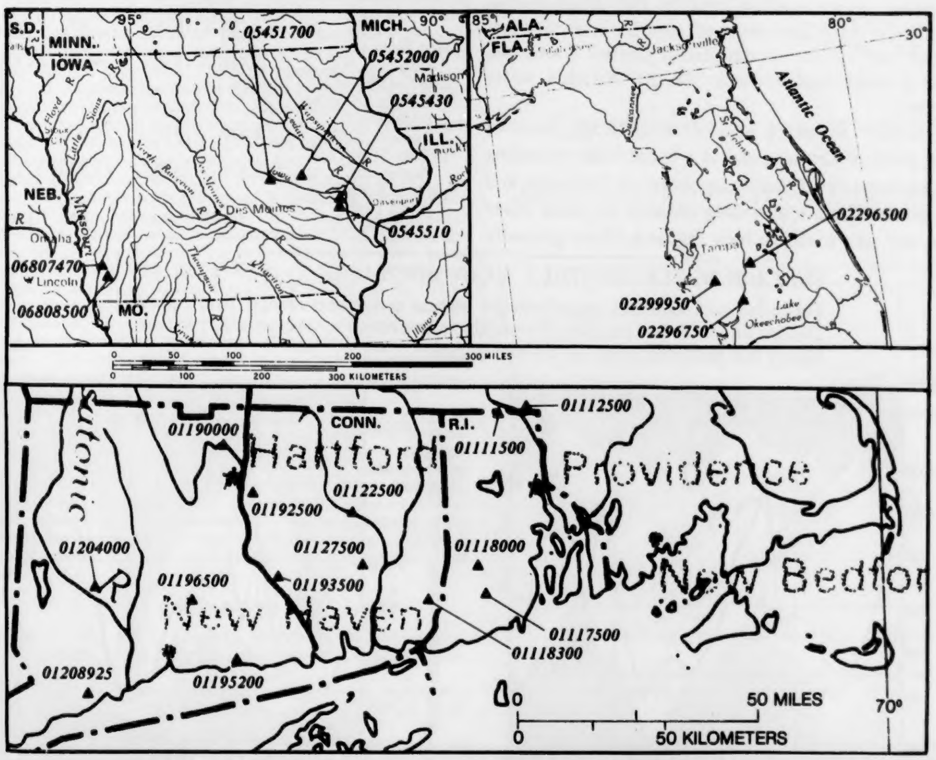
WRD station number	Stream and place of determination	Drainage area (square miles)	Period of known floods	Maximum flood previously known			Maximum during present flood				
				Date	Stage (feet)	Discharge (cfs)	Date	Stage (feet)	Discharge		Recurrence interval (years)
									Cfs	Cfs per square mile	
	CONNECTICUT										
	PAWCATUCK RIVER BASIN										
01118300	Pendleton Hill Brook near Clark Falls	4.02	1958–	Jan. 21, 1979	6.41	492	June 5	6.73	568	141	50
	THAMES RIVER BASIN										
01122500	Shetucket River near Willimantic	402	1904–05, 1919–21, 1928–	Sept. 21, 1938	27.6	52,200	6	14.72	15,400	38	25
01127500	Yantic River at Yantic	90.0	1930–	Sept. 21, 1938	14.66	13,500	6	14.88	8,900	99	100
	CONNECTICUT RIVER BASIN										
01190000	Farmington River at Rainbow	589	1928–	Aug. 19, 1955	23.5	69,200	7	11.70	19,600	33	10
01192500	Hockanum River near East Hartford	73.4	1919–21, 1928–	Sept. 21, 1938	13.78	5,160	6	10.85	2,680	37	20
01193500	Salmon River near East Hampton	102	1928–	Jan. 25, 1979	12.67	12,900	6	14.4	12,000	118	75
	EAST RIVER BASIN										
01195200	Neck River near Madison ..	6.55	1961–	Jan. 26, 1978	6.37	560	5	7.6	700	107	50
	QUINNIPIAC RIVER BASIN										
01196500	Quinnipiac River at Wallingford	110	1930–	Jan. 25, 1979	12.93	5,580	6	14.02	8,200	75	>100
	HOUSATONIC RIVER BASIN										
01204000	Pomperaug River at Southbury	75.0	1932–	Aug. 19, 1955	21.8	29,400	5	13.38	7,080	94	15
	MILL RIVER BASIN										
01208925	Mill River near Fairfield ...	28.5	1972–	Apr. 10, 1980	7.15	1,800	5	7.0	1,710	60	15
	FLORIDA										
	PEACE RIVER BASIN										
02296500	Charlie Creek near Gardner	330	1950–	Aug. 1, 1960	18.77	8,160	June 21	17.76	5,800	18	10
02296750	Peace River at Arcadia	1,367	1931–	Sept. 9, 1933	19.92	36,200	23	17.79	17,100	13	12
	MANATEE RIVER BASIN										
02299950	Manatee River near Myakka Head	65.3	1966–	Aug. 15, 1976	15.33	3,130	18	17.60	5,500	84	50
	IOWA										
	IOWA RIVER BASIN										
05451700	Timber Creek near Marshalltown	118	1949–	Aug. 16, 1977	17.69	12,000	June 15	17.25	9,600	81	50
05452000	Salt Creek near Elberon ..	201	1945–	June 13, 1947	17.6	35,000	15	20.0	[a]20,000	100	>100
05454300	Clear Creek near Coralville	98.1	1952–	May 17, 1974	13.93	6,630	15	14.61	11,000	112	100
05455100	Old Mans Creek near Iowa City	201	1950–	May 29, 1962	14.52	12,000	17	15.3	[a]13,000	65	100
	NISHNABOTNA RIVER BASIN										
06807470	Indian Creek near Emerson	37.3	1966–	June 21, 1967	91.16	(b)	15	92.56	(b)	.....	>100

Provisional data; subject to revision

STAGES AND DISCHARGES FOR THE FLOODS OF JUNE 1982 AT SELECTED SITES IN CONNECTICUT, FLORIDA, IOWA, AND RHODE ISLAND—Continued

WRD station number	Stream and place of determination	Drainage area (square miles)	Period of known floods	Maximum flood previously known: Date	Maximum flood previously known: Stage (feet)	Maximum flood previously known: Discharge (cfs)	Maximum during present flood: Date	Maximum during present flood: Stage (feet)	Maximum during present flood: Discharge: Cfs	Maximum during present flood: Discharge: Cfs per square mile	Maximum during present flood: Recurrence interval (years)
	IOWA—Continued										
	NISIHNABOTNA RIVER BASIN—Continued										
06808500	West Nishnabotna River at Randolph..........	1,326	1948–	June 21, 1967	22.60	35,500	June 15	23.39	26,000	22	20
	RHODE ISLAND										
	BLACKSTONE RIVER BASIN										
01111500	Branch River at Forestdale	91.2	1909, 1912–13, 1940–	Mar. 19, 1936	(c)	5,800	June 6	11.15	4,800	53	30
01112500	Blackstone River at Woonsocket	416	1929–	Aug. 19, 1955	21.80	32,900	7	13.16	12,600	30	20
	PAWCATUCK RIVER BASIN										
01117500	Pawcatuck River at Wood River Junction ...	100	1940–	Mar. 19, 1968	7.80	1,700	7	8.75	1,860	19	>100
01118000	Wood River at Hope Valley	72.4	1909, 1941–	Mar. 22, 1980	[d]8.67	1,770	6	10.26	2,500	35	>100

[a]Estimated.
[b]Discharge not determined.
[c]Maximum gage height, 11.90 ft on Mar. 18, 1968.
[d]Maximum gage height, 12.4 ft during February 1886.



Location of stream-gaging stations in Connecticut, Florida, Iowa, and Rhode Island, described in table of peak stages and discharges.

(Continued from page 2.)
290 square miles) was the result of runoff from over 5 inches of rain in a 12-hour period that fell on the saturated ground. That flow was highest in period of record that spans 51 years and exceeded the previous maximum of 21,900 cfs that occurred on September 13, 1977.

Runoff from intense rains on June 15 also caused local severe flooding in the city of Fayetteville in northwest **Arkansas**; however, peak discharges at gaging stations on the Illinois River near Savoy and the White River near Fayetteville did not exceed the 20-year recurrence interval. Damage to homes, businesses, streets, and culverts was reported to be about $1 million in Fayetteville.

Elsewhere, in **Indiana**, moderate flooding of some agricultural areas in the central part of the State occurred at mid-month, and in **West Virginia**, runoff from locally intense rains early in the month caused about 50-year recurrence interval floods on Little Creek and Slaughter Creek in the Charleston area. Also, in **North Carolina**, severe flooding occurred in the Concord area and Interstate Highway I-85 was flooded for several hours on June 18.

The above-normal trend in streamflow was also reflected in the combined flow of three large rivers—Mississippi, St. Lawrence, and Columbia—which averaged 1,784,300 cubic feet per second during June, 32 percent above median, and in the above-normal range. These three large rivers account for stream runoff in about half of the conterminous United States and provide a quick useful check on the Nation's water resources.

Streamflow increased in southern Florida, most of Alaska, parts of Ontario, and in a broad band extending from southwestern Canada southeast to Colorado and then east to Virginia, including most of the Ohio River Valley, and also southern New England. Flows generally decreased seasonally elsewhere in the United States and southeastern Canada. Monthly mean flows remained in the below-normal range in parts of Florida, Mississippi, Ontario, and Wisconsin, and were lowest of record for June in parts of Arizona.

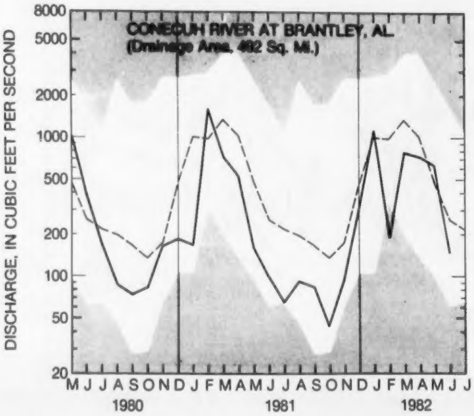
Monthly mean discharges remained in the above-normal range in parts of California, Florida, Idaho, Iowa, Missouri, Nebraska, North Dakota, Oklahoma, and Oregon, and increased into that range in large areas along the East Coast, the Midcontinent, and the Pacific Northwest.

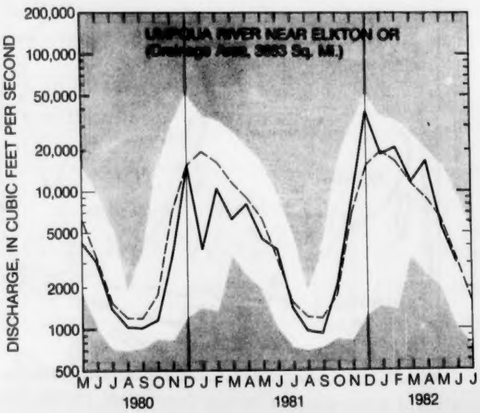
Highest flows of record for June were established at some index streams in Connecticut, Florida, Massachusetts, North Carolina, South Carolina, and Rhode Island. Listed below are rivers with new maximum monthly or daily flows (in cubic feet per second) for June:

Station	Drainage area (square miles)	Record began (year)	Monthly mean discharge	Daily mean discharge	Day
Mount Hope River near Warrenville, Conn . .	28.6	1940–	204	1,780	6
Salmon River near East Hampton, Conn . . .	102	1928–	714	6,430	6
Pomperaug River at Southbury, Conn . .	75.0	1932–	490	3,300	6
Peace River at Arcadia, Fla	1,367	1931–	6,176	17,970	23
Ware River at Intake Works near Barre, Mass.	96.8	1928–	490	. . . . .	. . .
Deep River at Moncure, N.C	1,410	1930–	4,014	22,400	11
Cape Fear River at William O Huske Lock near Tarheel, N.C	4,810	1937–	14,000	. . . . .	. . .
Pee Dee River at Peedee, S.C.	8,830	1938–	18,500	. . . . .	. . .
Pawcatuck River at Wood River Junction, R.I.	100	1940–	720	1,830	7

SURFACE WATER–MONTHLY MEAN DISCHARGE IN KEY STREAMS

Unshaded area indicates range between highest and lowest record for the month.
Dashed line indicates median of monthly values for reference period, 1951–80.
Heavy line indicates mean for current period.





RESERVOIRS AND WITHDRAWALS FOR WATER SUPPLY

By Walter B. Langbein[1]

Figure 1 shows the growth in capacity of major reservoirs in the United States according to U.S. Geological Survey and U.S. Army Corps of Engineers sources. The growth rate for total capacity averaged about 80 percent per decade until the early 1960's. Since then, reservoir capacity has increased at a markedly slower rate, the effects of approaching an asymptotic limit on capacity in some areas, compounded perhaps, by increasing public aversion towards reservoir construction (Holmes, 1979, p. 113 et seq.)

Reservoirs serve many purposes, such as flood control, irrigation, municipal water supply, or hydroelectric power generation. Much of the growth in capacity, especially after 1930, took place in multipurpose reservoirs that provided economics of scale and of combination. This trend was made possible by a change in technology that increased the number of practical damsites.

Figure 1 shows a potential or asymptotic limit to usable storage capacity in the United States which was inferred from the results of river-basin planning during 1945–60's when diligent search was made for practical or feasible reservoir sites.

These surveys indicated a potential limit of about 400 acre-feet of usable reservoir capacity per square mile, or about 1,200 million acre-feet for the country (conterminous) as shown in figure 1. Since about 450 million acre-feet of usable capacity is already developed, this leaves 750 million acre-feet for potential development.

The remaining or potential 750 million acre-feet is apt to be high cost (cheap sites are already in use) or ruled out by environmental considerations. If so, then the reservoir capacity may be approaching an asymptote lower than that suggested above.

Water supply constitutes one of the essential reasons for building reservoirs. The reservoir regulates the naturally varying streamflow so that it matches more nearly the withdrawals of water that are made by municipalities, industry, and for irrigation. These are therefore called the "withdrawal" uses. Figure 1 also shows the development of reservoir capacity that is available for the withdrawal uses.

Comparison of the two graphs on figure 1, the one showing capacity for all purposes and that showing capacity for withdrawal purposes constituted about 50 percent of the total; in 1980, withdrawal purposes made up only 39 percent of the total capacity for all purposes. The first reservoirs were built for withdrawal purposes (Martin and Hanson, 1966, p. 1) and so this downward trend has a long history. Most reservoir capacity now serves purposes such as flood control or power generation, unless increased withdrawal for water supply has induced a reallocation of existing capacity toward withdrawal uses.

Figure 2 compares the development of reservoir capacity for withdrawal purposes with the actual withdrawals from surface supplies (streams, lakes) as reported by Picton (1960) through 1950, and by the U.S. Geological Survey since 1950 (Murray and Reeves, 1972). A provisional figure is available for 1980, based on the inventory of water use now in preparation. Withdrawals and capacity are clearly related through 1970. But, in the 1970–1980 decade, capacity did not keep up with the continued increase in withdrawals. The historic relation on figure 2 appears to be shifting to one with a greater rate of withdrawal per unit of capacity. This suggests a decrease in reliability from less than 2 percent chance of deficiency to greater than 2 percent (Hardison, 1972).

In sum, the graphs on figure 1 indicate a lessening role of reservoirs in the future development of water resources, far short of potentials. The trend toward non-structural measures places greater dependence on management skill and on understanding the nature of river behavior. At some point, as yet unknown, the potentials of conservation and better management may become less effective than reservoirs. If so, the flattening of the graphs on figure 1 would be seen as merely an inflection along a generally upward trend in capacity, albeit at a rate slower than formerly.

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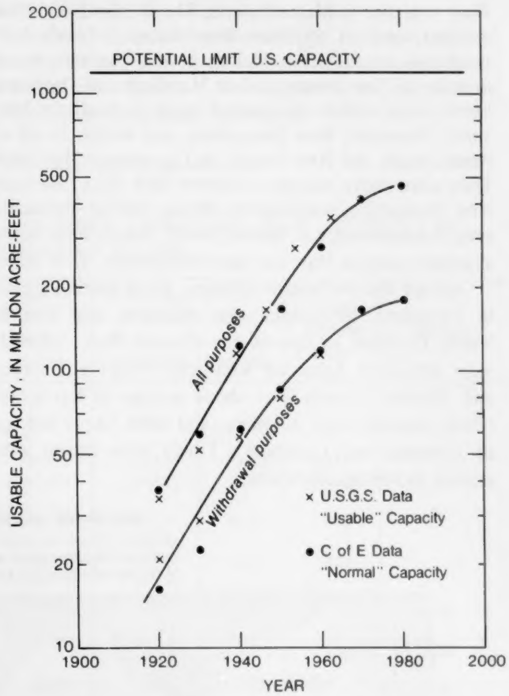


Figure 1.—Trend in reservoir capacity in major reservoirs in the United States since 1920.

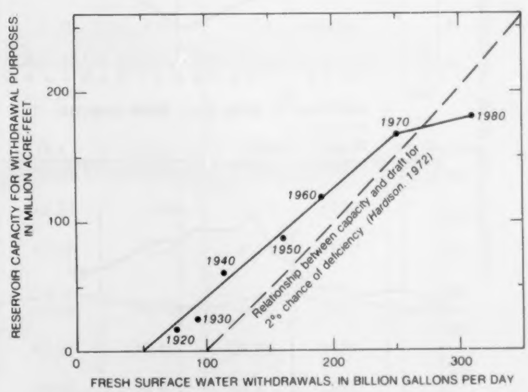


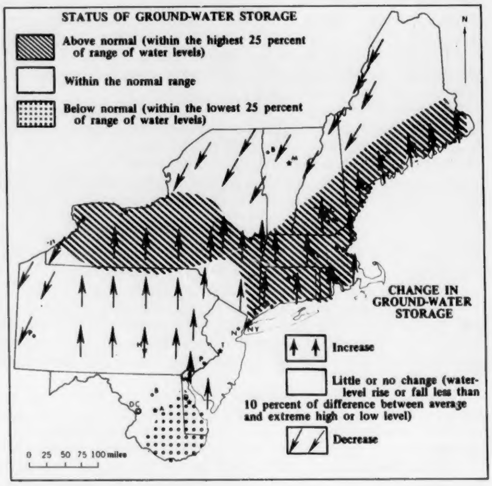
Figure 2.—Relations between reservoir capacity and withdrawals of surface water, 1920–80.

[1] Based on: Langbein, W. B., 1982, *Dams, reservoirs and withdrawals for water supply—historic trends:* U.S. Geological Survey Open-file Report 82-256, 9 p.

GROUND-WATER CONDITIONS DURING JUNE, 1982

In the eastern States, ground-water levels rose in the eastern three-fourths of Pennsylvania, southern New York, southern New Hampshire, and southern Maine. They rose also in Massachusetts, Rhode Island, and Connecticut, and in southern New Jersey. Levels held steady in northeastern Maine, in the northern three-fourths of New Jersey, and in Maryland and Delaware. Levels were within the normal range in northern New York, Vermont, New Hampshire, and Maine, in all of Pennsylvania and New Jersey, and in western Maryland. They were above average in western New York, southern New Hampshire, southeastern Maine, and in Massachusetts, Connecticut, and Rhode Island. Levels were below average in eastern Maryland and in Delaware. (See map.)

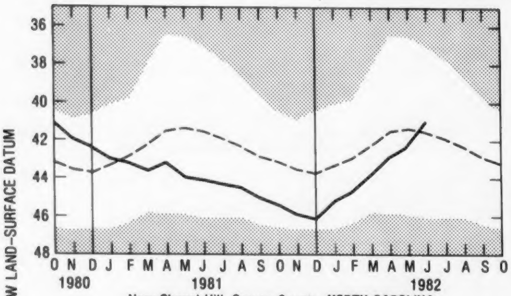
Among the southeastern States, water levels declined in Louisiana, Mississippi, and Alabama, and rose in North Carolina except in the Coastal Plain. Trends were mixed in Arkansas, Kentucky, Virginia, Georgia, and Florida. Levels were above average in Kentucky, North Carolina, and Alabama, and were below average in Arkansas and Louisiana. Levels were mixed with respect to average elsewhere.



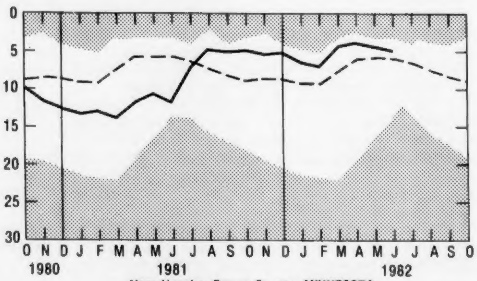
Map shows ground-water storage near end of June and change in ground-water storage from end of May to end of June.

MONTH-END GROUND-WATER LEVELS IN KEY WELLS

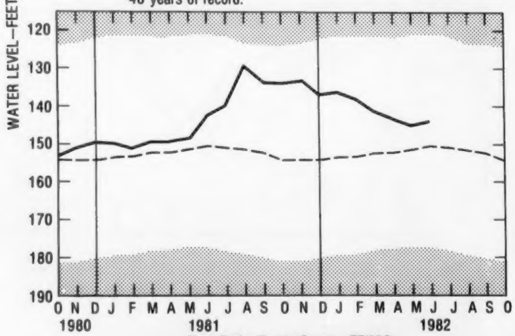
UNSHADED AREA INDICATES RANGE BETWEEN HIGHEST AND LOWEST RECORD FOR THE MONTH
DOTTED LINE INDICATES AVERAGE OF MONTHLY LEVELS, IN PREVIOUS YEARS
HEAVY LINE INDICATES LEVEL FOR CURRENT PERIOD



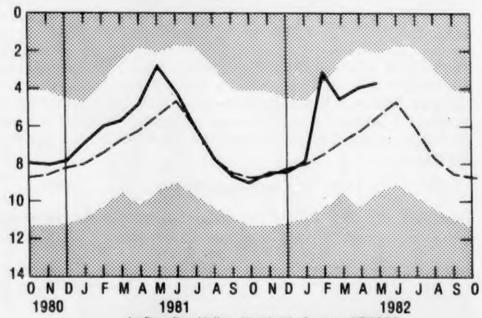
Near Chapel Hill, Orange County, **NORTH CAROLINA;**
in Granite;
46 years of record.



Near Hanska, Brown County, **MINNESOTA;**
in glacial deposits;
39 years of record.



Near Buda, Travis County, **TEXAS;**
in Edwards Limestone;
38 years of record.



At Paradise Valley, Humboldt County, **NEVADA;**
in Quaternary alluvium;
36 years of record.

A new high ground-water level for June was recorded in Alabama, and new June lows were reached in Arkansas and Tennessee.

Among the Great Lakes States, ground-water levels declined in Michigan, Iowa, and Ohio; trends were mixed elsewhere. Levels were above average in Iowa, and near average or above and below average in other States.

Among the western States, ground-water levels declined in Washington, southern California, and in much of Utah, Nevada, and Texas. Trends were mixed elsewhere. Levels were above average in Washington and Nebraska, below average in Arizona, New Mexico, and in much of Utah and Texas. Levels were above and below average elsewhere.

A new high ground-water level for June was reported for Nebraska. New June lows were recorded in Utah, Kansas, and Arizona. New alltime low ground-water levels occurred in Idaho and Texas.

WATER LEVELS IN KEY OBSERVATION WELLS IN SOME REPRESENTATIVE AQUIFERS IN THE CONTERMINOUS UNITED STATES

Aquifer and location	Current water level in feet below land-surface datum	Departure from average in feet	Net change in water level in feet since: Last month	Net change in water level in feet since: Last year	Year records began	Remarks
Glacial drift at Hanska, south-central Minnesota	-4.95	+0.73	-0.41	+0.66	1943	
Glacial drift at Roscommon in north-central part of Southern Peninsula, Michigan	-4.21	+0.03	-0.41	+0.08	1935	
Glacial drift at Marion, Iowa	-10.64	+2.50	-0.25	-0.22	1941	
Glacial drift at Princeton in northwestern Illinois	-8.17	+1.30	-0.17	-0.97	1943	
Petersburg Granite, southeastern Piedmont near Fall Zone, Colonial Heights, Virginia	-15.20	+0.25	-0.52	+0.63	1939	
Glacial outwash sand and gravel, Louisville, Kentucky	-18.20	+7.51	+0.06	+0.28	1946	
500-foot sand aquifer near Memphis, Tennessee (U.S. well no. 2)	-103.29	-15.47	-0.11	-0.27	1941	June low.
Granite in eastern Piedmont Province, Chapel Hill, North Carolina	-40.85	+0.65	+1.44	+3.25	1931	
Sparta Sand in Pine Bluff industrial area, Arkansas	-235.40	-31.57	+1.55	+6.35	1958	June low.
Copper Ridge and Chepultepec Dolomites, Centreville, Alabama	-28.3	+0.7	-0.7	-2.5	1952	
Limestone aquifer on Cockspur Island, Savannah area, Georgia	-24.40	-6.38	-0.60	+1.75	1956	
Sand and gravel in Puget Trough, Tacoma, Washington	-105.51	+5.42	-3.77	-0.39	1952	
Pleistocene glacial outwash gravel, North Pole, northern Idaho (U.S. well no. 3)	-458.4	+1.1	+1.0	+7.6	1929	
Snake River Group: southwestern Snake River Plain aquifer, at Eden, Idaho	-127.6	-9.4	+1.2	-2.2	1957	Alltime low.
Terrace gravel at Missoula, Montana	-9.1	+2.39	+5.40	+3.04	1960	
Alluvial sand and gravel, Platte River Valley, Nebraska (U.S. well no. 6)	-2.12	+2.50	-1.90	+5.88	1935	
Alluvial valley fill in Steptoe Valley, Nevada	-10.64	+2.50	-0.25	-0.22	1950	
Ogallala Formation, Kansas Agricultural Experiment Station at Colby in the High Plains of northwestern Kansas	-127.47	-7.88	+0.13	-0.21	1947	June low.
Alluvium and Paso Robles, clay, sand, and gravel, Santa Maria Valley, California	-137.08	+7.53	-11.48	-21.89	1957	
Valley fill, Elfrida area, Douglas, Arizona (U.S. well no. 15)	-112.5	-34.90	-0.8	+0.5	1951	
Berrendo-Smith well in San Andres Limestone, Roswell artesian basin of Pecos Valley, New Mexico (U.S. well no. 1-A)	-66.39	+0.10	+0.56	+0.23	1966	
Hueco bolson, El Paso area, Texas	-262.43	-16.00	-1.99	-2.00	1965	Alltime low.
Evangeline aquifer, Houston area, Texas	-323.34	-28.97	-6.43	-5.07	1965	

SELECTED DATA FOR THE GREAT LAKES, GREAT SALT LAKE, AND OTHER HYDROLOGIC SITES

GREAT LAKES LEVELS

Water levels are expressed as elevations in feet above International Great Lakes Datum 1955

(Data furnished by National Ocean Survey, NOAA, via U.S. Army Corps of Engineers office in Detroit. To convert data to elevations in feet above National Geodetic Vertical Datum of 1929 (NGVD), formerly called sea level datum of 1929, add the following values: Superior, 0.96; Michigan-Huron, 1.20; St. Clair, 1.24; Erie, 1.57; Ontario, 1.22.)

Lake	June 30, 1982	Monthly mean, June		June		
		1982	1981	Average 1900–75	Maximum (year)	Minimum (year)
Superior (Marquette, Mich.)	600.51	600.50	600.78	600.67	601.67 (1951)	598.63 (1926)
Michigan and Huron (Harbor Beach, Mich.)	578.92	578.87	579.30	578.54	580.89 (1973)	575.90 (1964)
St. Clair (St. Clair Shores, Mich.)	574.90	574.85	574.84	573.77	576.23 (1973)	571.74 (1934)
Erie (Cleveland, Ohio)	572.27	572.35	572.19	570.96	573.51 (1973)	568.46 (1934)
Ontario (Oswego, N.Y.)	245.90	245.75	245.38	245.55	248.06 (1952)	242.91 (1935)

LAKE WINNIPEG AT GIMLI, MANITOBA

Alltime high: 718.26 (July 1974). Alltime low: 709.62 (February 1941).	Monthly mean, June				
	1982	1981	Average 1913–81	Maximum (year)	Minimum (year)
Elevation in feet above NGVD:	714.11	712.89	714.00	717.91 (1974)	710.47 (1941)

GREAT SALT LAKE

Alltime high: 4,211.6 (1873). Alltime low: 4,191.35 (October 1963).	June 30, 1982	June 30, 1981	June		
			Average, 1904–81	Maximum (year)	Minimum (year)
Elevation in feet above NGVD:	4,200.60	4,199.95	4,199.01	4,204.80 (1923)	4,192.75 (1963)

LAKE CHAMPLAIN, AT ROUSES POINT, N.Y.

Alltime high (1827–1980): 102.1 (1869). Alltime low (1939–1980): 92.17 (1941).	June 29, 1982	June 30, 1981	June		
			Average, 1939–78	Max. daily (year)	Min. daily (year)
Elevation in feet above NGVD:	96.41	96.02	96.91	101.02 (1947)	94.35 (1965)

FLORIDA

Site	June 1982		May 1982	June 1981
	Discharge in cfs	Percent of normal	Discharge in cfs	Discharge in cfs
Silver Springs near Ocala (northern Florida)	960	120	860	650
Miami Canal at Miami (southeastern Florida)	244	76	65	4
Tamiami Canal outlets, 40-mile bend to Monroe	1,070	1,250	25	9

FLOW OF LARGE RIVERS DURING JUNE 1982

Station number	Stream and place of determination	Drainage area (square miles)	Mean annual discharge through September 1980 (cubic feet per second)	June 1982: Monthly mean discharge (cubic feet per second)	June 1982: Percent of median monthly discharge, 1951–80	June 1982: Change in discharge from pervious month (percent)	June 1982: Discharge near end of month: Cubic feet per second	June 1982: Discharge near end of month: Million gallons per day	June 1982: Discharge near end of month: Date
01014000	St. John River below Fish River at Fort Kent, Maine	5,690	9,647	5,810	61	-84	5,750	3,716	30
01318500	Hudson River at Hadley, N.Y	1,664	2,909	2,610	126	-35	1,650	1,066	30
01357500	Mohawk River at Cohoes, N.Y	3,456	5,734	6,500	246	+42	2,250	1,454	30
01463500	Delaware River at Trenton, N.J	6,780	11,750	13,640	190	+46	8,250	5,332	29
01570500	Susquehanna River at Harrisburg, Pa	24,100	34,530	59,000	316	+174	19,100	12,340	29
01646500	Potomac River near Washington, D.C.	11,560	[1]11,490	22,620	298	+171	6,630	4,285	30
02105500	Cape Fear River at William O. Huske Lock near Tarheel, N.C.	4,810	5,005	14,000	550	+204	3,000	1,900	30
02131000	Pee Dee River at Peedee, S.C	8,830	9,851	18,500	241	+86	7,130	4,608	30
02226000	Altamaha River at Doctortown, Ga	13,600	13,880	10,460	136	-29	6,550	4,233	29
02320500	Suwannee River at Branford, Fla	7,880	6,987	3,800	72	-42	4,270	2,759	27
02358000	Apalachicola River at Chattahoochee, Fla	17,200	22,570	14,600	91	-29	12,700	8,210	28
02467000	Tombigbee River at Demopolis lock and dam near Coatopa, Ala	15,400	23,300	15,990	218	+2	13,200	8,530	30
02489500	Pearl River near Bogalusa, La	6,630	9,768	2,210	56	-68	3,520	2,275	30
03049500	Allegheny River at Natrona, Pa	11,410	[1]19,480	28,300	302	+110	8,400	5,430	28
03085000	Monongahela River at Braddock, Pa.	7,337	[1]12,510	12,180	204	+225	2,450	1,583	28
03193000	Kanawha River at Kanawha Falls, W. Va	8,367	12,590	18,360	261	+143	6,330	4,091	24
03234500	Scioto River at Higby, Ohio	5,131	4,547	3,401	113	+68	1,920	1,240	30
03294500	Ohio River at Louisville, Ky[2]	91,170	116,000	132,600	211	+142	35,800	23,140	27
03377500	Wabash River at Mount Carmel, Ill	28,635	27,220	39,896	194	+59	20,200	13,060	28
03469000	French Broad River below Douglas Dam, Tenn	4,543	6,798	5,818	108	+4	......	......	....
04084500	Fox River at Rapide Croche Dam, near Wrightstown, Wis[2]	6,150	4,163	2,594	71	-23	1,386	895	23
04264331	St. Lawrence River at Cornwall, Ontario–near Massena, N.Y[3]	299,000	242,700	289,800	103	+1	294,000	190,000	30
050115	St. Maurice River at Grand Mere, Quebec	16,300	25,150	20,900	71	-72	14,700	9,500	29
05082500	Red River of the North at Grand Forks, N. Dak	30,100	2,551	3,280	79	-45	2,600	1,680	30
05133500	Rainy River at Manitou Rapids, Minn.	19,400	12,830	23,400	114	-3	13,000	8,400	27
05330000	Minnesota River near Jordan, Minn.	16,200	3,402	6,847	119	-17	3,900	2,520	30
05331000	Mississippi River at St. Paul, Minn	36,800	[1]10,610	20,137	120	-43	14,200	9,180	30
05365500	Chippewa River at Chippewa Falls, Wis.	5,600	5,100	3,197	61	-72	1,650	1,066	20
05407000	Wisconsin River at Muscoda, Wis	10,300	8,617	6,554	67	-53	......	......	....
05446500	Rock River near Joslin, Ill	9,551	5,873	8,220	141	-5	8,000	5,200	30
05474500	Mississippi River at Keokuk, Iowa	119,000	62,620	112,700	132	-27	75,700	48,930	30
06214500	Yellowstone River at Billings, Mont	11,796	7,038	30,010	103	+159	49,000	31,700	29
06934500	Missouri River at Hermann, Mo	524,200	79,490	223,400	259	+78	127,100	82,150	30
07289000	Mississippi River at Vicksburg, Miss[4]	1,140,500	576,600	871,200	165	+40	786,000	508,000	28
07331000	Washita River near Dickson, Okla.	7,202	1,368	7,072	539	-30	4,400	2,840	30
08276500	Rio Grande below Taos Junction Bridge, near Taos, N. Mex	9,730	725	1,938	267	+29	1,720	1,111	30
09315000	Green River at Green River, Utah.	40,600	6,298	15,203	89	+10	15,300	9,890	25
11425500	Sacramento River at Verona, Calif	21,257	18,820	19,190	169	-43	14,600	9,440	30
13269000	Snake River at Weiser, Idaho	69,200	18,050	30,857	127	-32	29,580	19,118	28
13317000	Salmon River at White Bird, Idaho	13,550	11,250	67,030	156	+60	80,550	52,060	28
13342500	Clearwater River at Spalding, Idaho	9,570	15,480	57,813	147	+10	43,760	28,282	28
14105700	Columbia River at The Dalles, Oreg[5]	237,000	193,100	623,300	130	+40	402,400	260,080	27
14191000	Willamette River at Salem, Oreg.	7,280	23,510	12,130	101	-36	9,650	6,236	27
15515500	Tanana River at Nenana, Alaska.	25,600	23,460	55,163	118	+69	63,000	40,700	30
8MF005	Fraser River at Hope, British Columbia	83,800	96,290	307,550	124	+63	294,132	190,102	29

[1] Adjusted.
[2] Records furnished by Corps of Engineers.
[3] Records furnished by Buffalo District, Corps of Engineers, through International St. Lawrence River Board of Control. Discharges shown are considered to be the same as discharge at Ogdensburg, N.Y. when adjusted for storage in Lake St. Lawrence.
[4] Records of daily discharge computed jointly by Corps of Engineers and Geological Survey.
[5] Discharge determined from information furnished by Bureau of Reclamation, Corps of Engineers, and Geological Survey.

USABLE CONTENTS OF SELECTED RESERVOIRS NEAR END OF JUNE 1982

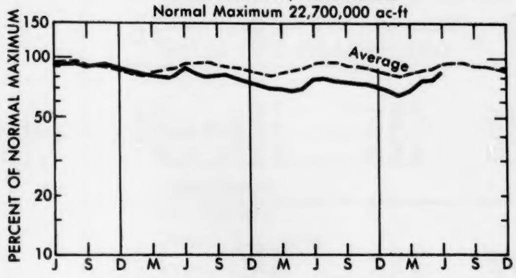
[Contents are expressed in percent of reservoir capacity. The usable storage capacity of each reservoir is shown in the column headed "Normal maximum."]

Reservoir Principal uses: F–Flood control I–Irrigation M–Municipal P–Power R–Recreation W–Industrial	Percent of normal maximum				Normal maximum (acre-feet)[a]
	End of June 1982	End of June 1981	Average for end of June	End of May 1982	
NORTHEAST REGION					
NOVA SCOTIA					
Rossignol, Mulgrave, Falls Lake, St. Margaret's Bay, Black, and Ponhook Reservoirs (P)	77	72	71	86	[b]226,300
QUEBEC					
Allard (P)	87	96	83	137	280,600
Gouin (P)	52	90	68	68	6,954,000
MAINE					
Seven reservoir systems (MP)	91	85	87	94	4,098,000
NEW HAMPSHIRE					
First Connecticut Lake (P)	92	94	90	92	76,450
Lake Francis (FPR)	83	90	87	89	99,310
Lake Winnipesaukee (PR)	102	102	96	105	165,700
VERMONT					
Harriman (P)	86	72	81	83	116,200
Somerset (P)	131	73	86	87	57,390
MASSACHUSETTS					
Cobble Mountain and Borden Brook (MP)	95	84	88	92	77,920
NEW YORK					
Great Sacandaga Lake (FPR)	96	97	92	98	786,700
Indian Lake (FMP)	95	95	101	88	103,300
New York City reservoir system (MW)	98	83	....	96	1,680,000
NEW JERSEY					
Wanaque (M)	101	90	89	99	85,100
PENNSYLVANIA					
Allegheny (FPR)	46	49	48	50	1,180,000
Pymatuning (FMR)	99	97	97	101	188,000
Raystown Lake (FR)	77	61	60	68	761,900
Lake Wallenpaupack (PR)	79	85	86	84	157,800
MARYLAND					
Baltimore municipal system (M)	86	87	93	83	255,800
SOUTHEAST REGION					
NORTH CAROLINA					
Bridgewater (Lake James) (P)	95	93	91	95	288,800
Narrows (Badin Lake) (P)	95	90	97	99	128,900
High Rock Lake (P)	89	82	78	97	234,800
SOUTH CAROLINA					
Lake Murray (P)	96	91	80	95	1,614,000
Lakes Marion and Moultrie (P)	85	87	75	84	1,862,000
SOUTH CAROLINA--GEORGIA					
Clark Hill (FP)	78	50	73	79	1,730,000
GEORGIA					
Burton (PR)	98	100	91	98	104,000
Sinclair (MPR)	88	87	91	89	214,000
Lake Sidney Lanier (FMPR)	62	56	66	61	1,686,000
ALABAMA					
Lake Martin (P)	109	97	92	99	1,373,000
TENNESSEE VALLEY					
Clinch Projects: Norris and Melton Hill Lakes (FPR)	37	57	62	60	2,229,300
Douglas Lake (FPR)	68	81	68	83	1,394,000
Hiwassee Projects: Chatuge, Nottely, Hiwassee, Apalachia, Blue Ridge, Ocoee 3, and Parksville Lakes (FPR)	79	72	81	79	1,012,000
Holston Projects: South Holston, Watauga, Boone, Fort Patrick Henry, and Cherokee Lakes (FPR)	70	68	68	67	2,880,000
Little Tennessee Projects: Nantahala, Thorpe, Fontana, and Chilhowee Lakes (FPR)	77	73	83	78	1,478,000
WESTERN GREAT LAKES REGION					
WISCONSIN					
Chippewa and Flambeau (PR)	85	97	87	94	365,000
Wisconsin River (21 reservoirs) (PR)	79	95	82	91	399,000
MINNESOTA					
Mississippi River headwater system (FMR)	35	34	39	43	1,640,000
MIDCONTINENT REGION					
NORTH DAKOTA					
Lake Sakakawea (Garrison) (FIPR)	84	78	93	77	22,700,000
SOUTH DAKOTA					
Angostura (I)	...	67	90	115	127,600
Bell Fourche (I)	...	55	70	92	185,200
Lake Francis Case (FIP)	...	78	83	83	4,834,000
Lake Oahe (FIP)	...	69	....	75	22,530,000
MIDCONTINENT REGION—Continued					
SOUTH DAKOTA—Continued					
Lake Sharpe (FIP)	...	99	100	101	1,725,000
Lewis and Clarke Lake (FIP)	...	81	88	92	477,000
NEBRASKA					
Lake McConaughy (IP)	85	84	80	85	1,948,000
OKLAHOMA					
Eufaula (FPR)	112	95	95	121	2,378,000
Keystone (FPR)	141	98	105	158	661,000
Tenkiller Ferry (FPR)	119	106	101	104	628,200
Lake Altus (FIMR)	84	26	70	60	133,000
Lake O'The Cherokees (FPR)	107	98	96	96	1,492,000
OKLAHOMA--TEXAS					
Lake Texoma (FMPRW)	132	99	101	130	2,722,000
TEXAS					
Bridgeport (IMW)	103	43	52	104	386,400
Canyon (FMR)	97	113	80	98	385,600
International Amistad (FIMPW)	97	99	81	101	3,497,000
International Falcon (FIMPW)	99	104	67	97	2,668,000
Livingston (IMW)	101	101	87	101	1,788,000
Possum Kingdom (IMPRW)	99	98	99	95	570,200
Red Bluff (PI)	15	20	27	16	307,000
Toledo Bend (P)	96	99	91	97	4,472,000
Twin Buttes (FIM)	49	53	30	51	177,800
Lake Kemp (IMW)	102	75	93	76	268,000
Lake Meredith (FWM)	34	16	37	32	796,900
Lake Travis (FIMPRW)	94	107	81	97	1,144,000
THE WEST					
WASHINGTON					
Ross (PR)	89	100	90	39	1,052,000
Franklin D. Roosevelt Lake (IP)	94	100	102	38	5,022,000
Lake Chelan (PR)	90	100	96	52	676,100
Lake Cushman (PR)	100	101	98	100	359,500
Lake Merwin (P)	103	105	105	102	245,600
IDAHO					
Boise River (4 reservoirs) (FIP)	98	94	90	80	1,235,000
Coeur d'Alene Lake (P)	88	96	84	142	238,500
Pend Oreille Lake (FP)	97	97	98	89	1,561,000
IDAHO--WYOMING					
Upper Snake River (8 reservoirs) (MP)	88	90	85	69	4,401,000
WYOMING					
Boysen (FIP)	78	92	89	55	802,000
Buffalo Bill (IP)	98	106	102	52	421,300
Keyhole (F)	31	34	51	28	190,400
Pathfinder, Seminoe, Alcova, Kortes, Glendo, and Guernsey Reservoirs (I)	64	64	64	52	3,056,000
COLORADO					
John Martin (FIR)	5	10	19	7	364,400
Taylor Park (IR)	58	73	95	27	106,200
Colorado–Big Thompson project (I)	61	76	75	48	722,600
COLORADO RIVER STORAGE PROJECT					
Lake Powell; Flaming Gorge, Fontenelle, Navajo, and Blue Mesa Reservoirs (IFPR)	89	86	....	82	31,620,000
UTAH--IDAHO					
Bear Lake (IPR)	88	76	70	81	1,421,000
CALIFORNIA					
Folsom (FIP)	96	78	88	97	1,000,000
Hetch Hetchy (MP)	100	99	82	79	360,400
Isabella (FIR)	98	52	48	86	568,100
Pine Flat (FI)	97	78	71	88	1,001,000
Clair Engle Lake (Lewiston) (P)	100	91	89	98	2,438,000
Lake Almanor (P)	109	82	65	108	1,036,000
Lake Berryessa (FIMW)	98	83	84	100	1,600,000
Millerton Lake (FI)	104	78	82	77	503,200
Shasta Lake (FIPR)	100	85	87	104	4,377,000
CALIFORNIA--NEVADA					
Lake Tahoe (IPR)	98	55	73	89	744,600
NEVADA					
Rye Patch (I)	76	61	68	62	194,300
ARIZONA--NEVADA					
Lake Mead and Lake Mohave (FIMP)	86	85	73	87	27,970,000
ARIZONA					
San Carlos (IP)	19	40	18	26	1,073,000
Salt and Verde River system (IMPR)	79	65	45	88	2,073,000
NEW MEXICO					
Conchas (FIR)	45	23	81	39	330,100
Elephant Butte and Caballo (FIPR)	38	40	30	33	2,453,000

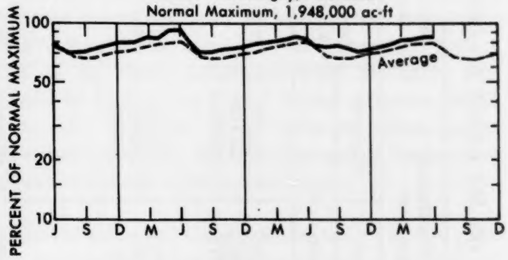
[a] 1 acre-foot = 0.0436 million cubic feet = 0.326 million gallons = 0.504 cubic feet per second day.
[b] Thousands of kilowatt-hours (the potential electric power that could be generated by the volume of water in storage).

USABLE CONTENTS OF SELECTED RESERVOIRS AND RESERVOIR SYSTEMS, JUNE 1979 TO JUNE 1982

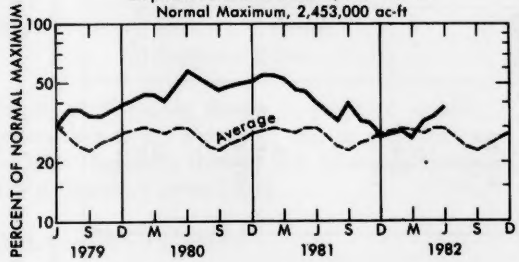
Lake Sakakawea, North Dakota
Normal Maximum 22,700,000 ac-ft



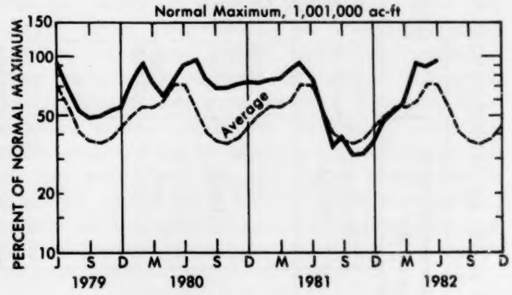
Lake McConaughy, Nebraska
Normal Maximum, 1,948,000 ac-ft



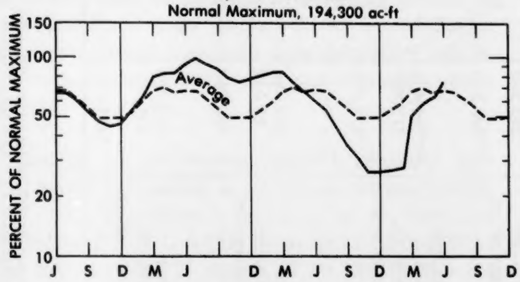
Elephant Butte and Caballo, New Mexico
Normal Maximum, 2,453,000 ac-ft



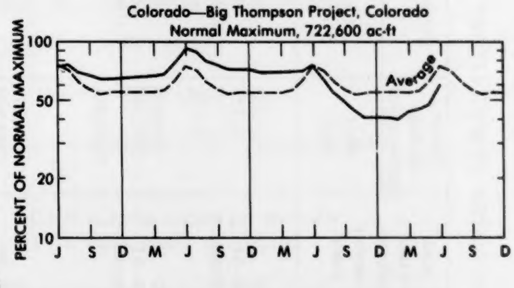
Pine Flat, California
Normal Maximum, 1,001,000 ac-ft



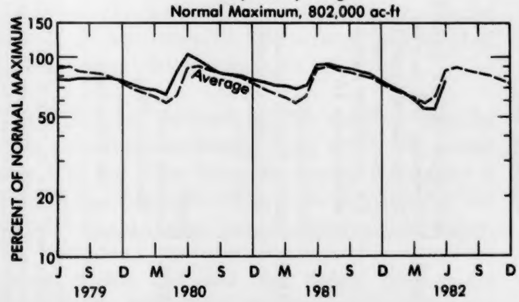
Rye Patch, Nevada
Normal Maximum, 194,300 ac-ft



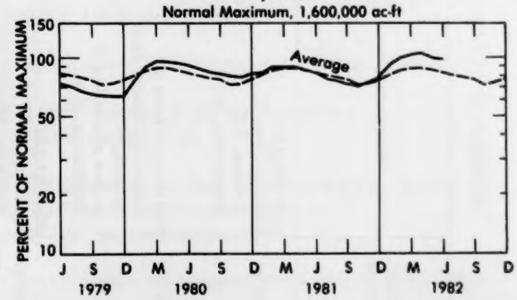
Colorado—Big Thompson Project, Colorado
Normal Maximum, 722,600 ac-ft



Boysen, Wyoming
Normal Maximum, 802,000 ac-ft



Lake Berryessa, California
Normal Maximum, 1,600,000 ac-ft



DISSOLVED SOLIDS AND WATER TEMPERATURES FOR JUNE AT DOWNSTREAM SITES ON SIX LARGE RIVERS

Station number	Station name	June data of following calendar years	Stream discharge during month: Mean (cfs)	Dissolved-solids concentration during month[a]: Minimum (mg/L)	Dissolved-solids concentration during month[a]: Maximum (mg/L)	Dissolved-solids discharge during month[a] (tons per day): Mean	Dissolved-solids discharge during month[a] (tons per day): Minimum	Dissolved-solids discharge during month[a] (tons per day): Maximum	Water temperature during month[b]: Mean, in °C	Water temperature during month[b]: Minimum, in °C	Water temperature during month[b]: Maximum, in °C
	NORTHEAST										
01463500	Delaware River at	1982	*13,700	87	109	3,370	2,310	5,490	20.5	16.0	24.0
	Trenton, N.J.	1945–81	9,329	60	143	......	495	22,100	.....	13.5	34.0
	(Morrisville, Pa.)	(Extreme yr)		(1945)	(1965)		(1965)	(1973)			
			c7,176								
04264331	St. Lawrence River at	1982	290,000	165	167	130,000	124,000	133,000	14.0	12.5	16.0
	Cornwall, Ontario, near	1976–81	307,300	165	171	137,000	110,000	250,000	15.0	11.5	18.0
	Massena, N.Y.	(Extreme yr)		(1981)	(1981)		(1977)	(1981)			
	median streamflow at		c280,200								
	Ogdensburg, N.Y.										
	SOUTHEAST										
07289000	Mississippi River at	1982	**871,200	....	....	......	....	....	.....	.....	.....
	Vicksburg, Miss.	1976–81	599,500	176	316	286,000	34,400	579,000	25.0	17.0	31.0
		(Extreme yr)		(1981)	(1976)		(1978)	(1979)			
			c546,500								
	WESTERN GREAT LAKES	*REGION*									
03612500	Ohio River at lock and dam	1982	***266,400	199	231	....	39,800	245,000	.....	23.5	25.0
	53, near Grand Chain, Ill.	1955–81	215,800	111	300	....	27,000	396,000	.....	16.5	30.5
	(25 miles west of Paducah,	(Extreme yr)		(1974)	(1970)		(1977)	(1981)			
	Ky.; streamflow station		c175,700								
	at Metropolis, Ill.)										
	MIDCONTINENT										
06934500	Missouri River at Hermann,	1982	223,000	213	328	153,000	111,000	187,000	22.0	19.0	25.0
	Mo. (60 miles west of St.	1976–81	88,630	207	448	80,300	44,000	165,000	24.0	20.5	28.0
	Louis, Mo.)	(Extreme yr)		(1977)	(1980)		(1977)	(1981)			
			c86,260								
	WEST										
14128910	Columbia River at	1982	357,000	63	82	73,100	60,500	89,400	15.0	13.0	17.0
	Warrendale, Oreg.	1976–81	246,300	61	107	52,500	19,100	97,900	15.5	12.5	19.5
	(streamflow station	(Extreme yr)		(1976)	(1977)		(1977)	(1981)			
	at The Dalles, Oreg.)		c481,150								

[a]Dissolved-solids concentrations when not analyzed directly, are calculated on basis of measurements of specific conductance.
[b]To convert °C to °F: [(1.8 X °C) + 32] = °F.
[c]Median of monthly values for 30-year reference period, water years 1951–80, for comparison with data for current month.
*Dissolved-solids and water-temperature records are for 22 days only (June 9–30).
**Dissolved-solids and water-temperature records are not available for June.
***Dissolved-solids and water-temperature records are for 25 days only (June 1–25).

WATER RESOURCES REVIEW

June 1982

Based on reports from the Canadian and U.S. Field offices; completed July 14, 1982

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EXPLANATION OF DATA

Cover map shows generalized pattern of streamflow for the month based on 18 index stream-gaging stations in Canada and 164 index stations in the United States. Alaska and Hawaii inset maps show streamflow only at the index gaging stations that are located near the points shown by the arrows.

Streamflow for the current month is compared with flow for the same month in the 30-year reference period, 1951–80. Streamflow is considered to be *below the normal range* if it is within the range of the low flows that have occurred 25 percent of the time (below the lower quartile) during the reference period. Flow is considered to be *above the normal range* if it is within the range of the high flows that have occurred 25 percent of the time (above the upper quartile).

Flow higher than the lower quartile but lower than the upper quartile is described as being *within the normal range*. In the Water Resources Review the median is obtained by ranking the 30 flows for each month of the reference period in their order of magnitude; the highest flow is number 1, the lowest flow is number 30, and the average of the 15th and 16th highest flows is the median. One-half of the time you would expect the flows for the month to be below the median and one-half of the time to be above the median.

Statements about *ground-water levels* refer to conditions near the end of the month. The water level in each key observation well is compared with average level for the end of the month determined from the entire past record for that well or from a 30-year reference period, 1951–80. *Changes in ground-water levels*, unless described otherwise, are from the end of the previous month to the end of the current month.

Dissolved solids and temperature data for June are given for six stream-sampling sites that are part of the National Stream Quality Accounting Network (NASQAN). Dissolved solids are minerals dissolved in water and usually consist predominantly of silica and ions of calcium, magnesium, sodium, potassium, carbonate, bicarbonate, sulfate, chloride, and nitrate. Dissolved-solids discharge represents the total daily amount of dissolved minerals carried by the stream. Dissolved-solids *concentrations* are generally higher during periods of low streamflow, but the highest dissolved-solids *discharges* occur during periods of high streamflow because the total quantities of water, and therefore total load of dissolved minerals, are so much greater than at time of low flow.

METRIC EQUIVALENTS OF UNITS USED IN THE WATER RESOURCES REVIEW

1 foot = 0.3048 meter

1 acre-foot = 1,233 cubic meters

1 million cubic feet = 28,320 cubic meters

1 cubic foot per second =
0.02832 cubic meters per second =
1.699 cubic meters per minute

1 cubic foot per second · day = 2,447 cubic meters

1 mile = 1.609 kilometers

1 square mile = 259 hectares = 2.59 square kilometers

1 million gallons = 3,785 cubic meters =
3.785 million liters

1 million gallons per day = 694.4 gallons per minute =
2.629 cubic meters per minute =
3,785 cubic meters per day

(Round-number conversions, to nearest four significant figures)

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